

REMARKS

The Examiner is thanked for the telephone interview courteously granted to the undersigned, on December 5, 2006, in connection with the above-identified application. During this interview, the Examiner's attention was directed to two features in all of the present claims, set forth in claim 10. The features are as follows:

Feature 1, that is, the gas-barrier layer being produced utilizing a dicarboxylic acid component containing 80-97 mol% of an  $\alpha$ ,  $\omega$ -linear aliphatic dicarboxylic acid and 3-20 mol% of isophthalic acid, as set forth in claim 10; and

Feature 2, that is, the polycondensation used to produce the polyamide, a polycondensing conducted by step (1) of melt-polymerizing and step (2) of solid-phase polymerizing, as set forth in claim 10.

Initially, during the interview it was indicated to the Examiner that the applied Harada, et al. patent, as applied by the Examiner, requires terephthalic acid, in addition to adipic acid and isophthalic acid, as the dicarboxylic acid component in forming the polyamide, and only discloses the applied combination of acids (adipic, isophthalic and terephthalic acids) in Comparative Example 2 (that is, a comparative example).

Moreover, during the interview unexpectedly better results achieved by the present invention, having the following two features recited in claim 10, were discussed:

Feature 1: the polyamide of the gas-barrier layer A is produced utilizing a dicarboxylic acid component containing 80-97 mol% of an  $\alpha$ ,  $\omega$ -linear aliphatic dicarboxylic acid and 3-20 mol% of isophthalic acid ; and

Feature 2: the polycondensation is conducted by steps (1) and (2), step (1) being melt-polymerizing the diamine component with the dicarboxylic component to produce polyamide, and then step (2) being a solid-phase polymerizing of the polyamide obtained in step (1), this solid-phase polymerizing being further defined.

During the interview, unexpectedly better results achieved by the present invention, having the aforementioned Features 1 and 2, were discussed, as compared with products of the prior art. Specifically, the Declaration of T. Kanda submitted with the Amendment filed January 4, 2006, as showing unexpectedly better results achieved according to the present invention as compared with products of Matlack, et al., was discussed. Also discussed were the Examples and Comparative Examples in Applicants' specification, particularly Comparative Example 1 on pages 22 and 23, showing unexpectedly better results achieved by the present invention as compared with structure formed according to the teachings of U.S. Patent No. 6,303,741 to Tanaka. No agreement was reached during the interview.

Applicants have amended their claims in order to further define various aspects of the present invention. Specifically, Applicants are adding new claims 14-16 to the application. Claim 14, dependent on claim 10, recites that the at least one gas-barrier layer A has a uniform thickness. Note, for example, Examples 1 and 2 on pages 14-18 of Applicants' specification, including, for example, the first full paragraph on page 16 and the fifth full paragraph on page 17. Claims 15 and 16, each dependent on claim 10, respectively recites that the dicarboxylic acid component "consists of", and "consists essentially of", 80-97 mol% of the C4-C 20 α, ω-linear aliphatic dicarboxylic acid and 3-20 mol% of isophthalic acid.

Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the prior art applied by the Examiner in rejecting claims in the Office Action mailed August 31, 2006, that is, the teachings of the U.S. patents to Matlack, et al., No. 5,028,462, to Harada, et al., No. 4,908,272, to Tanaka, No. 5,576,415 (Tanaka '415), and to Tanaka, No. 6,303,741 (Tanaka '741), under the provisions of 35 USC 103.

It is respectfully submitted that references applied by the Examiner would have neither taught nor would have suggested such a gas-barrier multi-layer structure as in the present claims, (a) wherein the gas-barrier layer A includes a crystallizable polyamide resin produced by polycondensing a specified diamine component with a dicarboxylic acid component containing 80-97 mol% of a C4-C20 α, ω-linear aliphatic dicarboxylic acid and 3-20 mol% of isophthalic acid, the crystallizable polyamide resin having a minimum half crystallization time of 40-2,000s in a measuring temperature range from a glass transition point thereof to less than a melting point thereof when measured by isothermal crystallization according to depolarization photometry, and (b) wherein the polycondensing is conducted by the following steps (1) and (2):

- (1) melt-polymerizing the diamine component with the dicarboxylic acid component to produce polyamide; and then
- (2) specified solid-phase polymerizing the polyamide obtained in step (1), wherein, inter alia, the relative viscosity of the polyamide resin thus obtained is in the range of 2.3-4.2.

See claim 10.

In addition, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such gas-barrier

multi-layer structure as in the present claims, having features as discussed previously in connection with claim 10; and, moreover, but not limited to, wherein the polyamide resin for the gas-barrier layer has an oxygen transmission coefficient as in claim 2; and/or wherein the polyamide resin has a melting point as in claim 3, or a glass transition point as in claim 4; and/or wherein the thermoplastic resin of the thermoplastic resin layer of the gas-barrier multi-layer structure has a Vicat softening point as in claim 5; and/or wherein the thermoplastic resin for the thermoplastic resin layer is a polyolefin (see claim 6) or polypropylene (see claim 13); and/or relative thickness of the gas-barrier layer as in claim 7; and/or wherein the gas-barrier and thermoplastic resin layers are laminated through an intervening adhesive resin layer, as in claim 8; and/or wherein the structure is a multi-layer container (see claim 9); and/or relative viscosity of the polyamide obtained in the step (1) of the polycondensing, as in claim 11; and/or wherein the at least one gas-barrier layer has a uniform thickness (see claim 14); and/or wherein the dicarboxylic acid component consists of (see claim 15), or consists essentially of (see claim 16), the specified amounts of the C4-C20  $\alpha$ ,  $\omega$ -linear aliphatic dicarboxylic acid and of isophthalic acid.

Moreover, it is respectfully submitted that the evidence of record establishes unexpectedly better results achieved by the gas-barrier multi-layer structure of the present claims, having the Features 1 and 2, that is, Feature 1: the diamine and dicarboxylic acid components polycondensed to form the crystallizable polyamide resin of the gas-barrier layer, and Feature 2: the polycondensing being conducted by melt-polymerizing and solid-phase polymerizing, establishing unobviousness of the presently claimed invention, even assuming, arguendo, that the combined teachings of the applied references would have established a prima facie case of obviousness.

The present invention is directed to a multi-layer structure having excellent gas-barrier properties, and also having fabricability, less malodor and discoloration and other excellent properties such as transparency and heat resistance.

Polyamides produced by the polycondensation of xylylenediamine and an aliphatic dicarboxylic acid such as, for example, adipic acid, have been extensively used as gas-barrier packaging materials such as films and bottles. Such polyamides have been used to form multi-layer structures composed, in addition to the polyamide, of a thermoplastic resin.

Gas-barrier multi-layer containers having a polyolefin layer and a polyamide layer have been proposed, as described on pages 2 and 3 of Applicants' Specification. However, problems arise in utilizing a higher-melting crystallizable polyamide together with a, e.g., polyolefin co-forming the multi-layer structure. That is, when a polyolefin and a higher-melting crystallizable polyamide are co-extruded into a multi-layer structure, the polyolefin resin is subjected to a severe heat history; and, in particular, in the production of a multi-layer structure containing polypropylene, discoloration, malodor generation, etc., due to heat degradation of the polypropylene resin, unfavorably occur.

As can be seen in the foregoing, it is still desired to develop a multi-layer structure comprising, e.g., a layer of polyamide produced from, among other reactants, m-xylylenediamine and adipic acid, with good fabricability and capable of providing containers that are fully satisfactory in transparency, heat resistance, appearance and gas-barrier properties.

Against this background, Applicants have found, as a result of extensive studies, that a multi-layer structure containing a crystallizable polyamide resin formed from a specific monomer composition, having specific crystallization rate, and

having been formed by a two-step polycondensing of (i) an initial step of melt-polymerizing and (ii) a second step of solid-phase polymerizing to obtain a polyamide resin with a specific relative viscosity, is excellent in fabricability, and has properties as desired.

Applicants have found that in obtaining the polyamide by melt polycondensation such polyamide has a relatively low molecular weight (relatively low viscosity), e.g., has a relative viscosity of 1.6–2.28. This low viscosity in turn causes drawbacks, for example, drawdown or gradual thickening of the polyamide layer towards the edges of sheets occurring when formed into multi-layer shaped articles such as films, sheets and bottles; and the thickness of the polyamide layer becomes uneven in the production of a bottle preform, thereby making the production of multi-layer shaped articles difficult. Applicants have further found that these drawbacks can be eliminated by further subjecting the melt-polymerization polyamide having a relatively low molecular weight to the solid-phase polymerization, e.g., at a temperature of 150°C up to the melting point of the polyamide, providing a polyamide resin having a relative viscosity in the range of 2.3 to 4.2. Note, for example, the paragraph bridging pages 5 and 6 of Applicants' Specification.

As to the unexpectedly better results achieved according to the present invention, wherein the polyamide has been formed by steps including, inter alia, solid-phase polymerization, attention is respectfully directed to the Declaration Under 37 CFR 1.132 of T. Kanda, one of the named inventors of the above-identified application, submitted with the Amendment filed January 4, 2006. Attention is, in particular, directed to Polyamides 4 and 5 described on pages 3 and 4 of this Declaration, which correspond to polyamides in Example 3 in Matlack, et al. It is respectfully submitted that these Polyamides 4 and 5 constitute the closest prior art in

connection with the presently claimed subject matter. Compare with Polyamides 1 and 2 on pages 2 and 3 of this Declaration, within the scope of the present invention. Attention is also directed to results discussed on pages 9 and 10, and in Table 6 on page 10 of this Declaration, and the discussion of the results as set forth on page 11. As can be seen, the polyamide resin according to the present invention contains superior effects in both formability of multi-layer sheets and formability of multi-layer containers, as compared with polyamide resins according to Matlack, et al., prepared by a polycondensation method without a solid-phase polymerization.

Thus, Feature 1 without Feature 2 of the present Claim 10, which is shown as Polyamides 4 and 5 of the Declaration, provides an Appearance "Bad" for formability of the multi-layer container.

Feature 2 without Feature 1 of the present Claim 10, which is shown as Polyamide 3 of the Declaration, provides an Appearance "Bad" for formability of the multi-layer container.

Hence, it is expected that the combination of both the effect of Feature 1 and the effect of Feature 2 would provide an Appearance "Bad" for the formability of the multi-layer container. However, Polyamides 1 and 2 of the Declaration (the polyamides within the scope of present Claim 10) provide an Appearance "Good" for formability of the multi-layer container, which is unexpected from the combination of the effect individually of Feature 1 and of Feature 2. That is, the present Claim 10 provides a superior Appearance "Good" for formability of the multi-layer container, which is unexpected from the effect of Feature 1 and the effect of Feature 2.

In the same way, the present Claim 10 provides a superior Thickness "Uniform" for formability of the multi-layer container, which is unexpected from the effect individually of Feature 1 and of Feature 2.

That is, the present Claim 10 provides superior effects in Appearance and Thickness for formability of the multi-layer container, which are unexpected from the effect individually of Feature 1 and of Feature 2.

As described above, the multi-layer container of the present invention provides superior effects, which are unexpected from the effect individually of Feature 1 and of Feature 2.

It is respectfully submitted that the results of this aforementioned Declaration show that the polyamide according to the present invention, prepared by processing techniques recited in the present claims, is a different polyamide than the polyamide resin of Matlack, et al., and provides unexpectedly better results as compared therewith. It is also respectfully submitted that the evidence in this Declaration supports patentability of the presently claimed subject matter.

Attention is also respectfully directed to the evidence in Applicants' specification, in particular, Comparative Examples 1, 2, 4 and 5, on pages 22-27 thereof, and Examples 1-6 on pages 14-22 thereof. This evidence in Applicants' specification must be considered in a determination under 35 USC 103. See In re DeBlauwe, 222 USPQ 191 (CAFC 1984). The Comparative Examples utilized the melt-polymerization/solid-phase polymerization as in the present claims, but utilized dicarboxylic acid components, in forming the polyamide resin for the layer A, outside the scope of the present claims. That is, in Comparative Example 1 the dicarboxylic acid component was composed of 100 mol% of adipic acid; and in Comparative Example 2 the dicarboxylic acid component was composed of 98 mol% of adipic acid and 2 mol% of isophthalic acid, thus each of Comparative Examples 1 and 2 being outside the scope of the present claims with amount of the aliphatic dicarboxylic acid being greater than that in the present claims and amount of isophthalic acid less than

that in the present claims. In contrast, Comparative Example 4 used a dicarboxylic acid component composed of 75 mol% of adipic acid and 25 mol% of isophthalic acid, and Comparative Example 5 used a dicarboxylic acid component composed of 60 mol% of adipic acid and 40 mol% of isophthalic acid, thus Comparative Examples 4 and 5 including amount of adipic acid less than that in the present claims and amounts of isophthalic acid greater than in the present claims. As indicated previously, all of these Comparative Examples 1, 2, 4 and 5 used the 2-step polycondensing as in the present claims. See also Polyamide 3 on page 3 of the Declaration submitted January 4, 2006, corresponding to Comparative Example 1 in Applicants' specification. As seen in the results in connection with Comparative Examples 1, 2, 4 and 5, and Polyamide 3, the resulting multi-layer structures have various problems such as malodor, haze, yellowness and non-uniformity of thickness. Compared with, for example, Examples 1-5 on pages 14-22 of Applicants' specification, the presently claimed subject matter, having a combination of features as discussed previously, including the recited dicarboxylic acid component, provides unexpectedly better results than where the structure is produced by a 2-step polycondensing as in the present claims, but without utilizing the dicarboxylic acid component of the polyamide as in the present claims.

As will be discussed further infra, a 2-step polycondensing procedure is described in Tanaka '741. However, Tanaka '741 does not disclose use of the dicarboxylic acid component as in claim 10. Assuming, arguendo, that Tanaka '741 constitutes the closest prior art, it is respectfully submitted that the evidence in Applicants' specification establishes unexpectedly better results achieved according to the present invention, utilizing both the dicarboxylic acid component and 2-step

polycondensing as in the present claims, even in light of the teachings of Tanaka '741, establishing unobviousness of the presently claimed subject matter.

In sum, and looking at all of the evidence of record being relied upon by Applicants, including the aforementioned Declaration submitted January 4, 2006 and the evidence in Applicants' specification, this evidence as a whole establishes unexpectedly better results achieved by the present invention including the combination of the Feature 1 of dicarboxylic acid component and of the Feature 2 of 2-step polycondensing, as compared with use of the dicarboxylic acid component with single-step polycondensing or 2-step polycondensing using a dicarboxylic acid component outside the scope of the present claims, and establishes unobviousness of the presently claimed subject matter.

During the aforementioned interview, the Examiner noted that the evidence of record does not include a comparison with structure disclosed by Harada, et al. Initially, it is respectfully submitted that Harada, et al. does not constitute the closest prior art. In this regard, it is noted that Harada, et al. requires inclusion of at least 5 mol% of terephthalic acid in the dicarboxylic acid component used in forming the polyamide. In connection therewith, note particularly new claims 15 and 16, reciting respectively that the dicarboxylic acid component "consists of", and "consists essentially of", the recited  $\alpha$ ,  $\omega$ -linear aliphatic dicarboxylic acid and isophthalic acid. It is respectfully submitted that Harada, et al. does not constitute the closest prior art, even in connection with the dicarboxylic acid component used in forming the polyamide. Moreover, note that Polyamide 4 of the Declaration of T. Kanda, submitted with the Amendment filed January 4, 2006, included 85 mol% of adipic acid and 15 mol% of isophthalic acid. It is respectfully submitted that this constitutes a closest composition, even in light of the teachings of Harada, et al. having a mol

ratio of 83% adipic acid and 11% isophthalic acid, so as to provide a proper test for establishing unobviousness of the presently claimed invention.

In sum, it is respectfully submitted that the evidence of record establishes unexpectedly better results for the presently claimed invention, having Features 1 and 2 in combination, as compared with structure formed with Feature 1 but without Feature 2, or with Feature 2 but without Feature 1, establishing unobviousness of the presently claimed invention.

Matlack, et al. discloses multi-layer bottles comprising inner and outer layers of a thermoplastic resin and at least one intermediate layer of a specific polyamide composition. Note column 1, lines 11-18. The polyamide composition is described most generally from column 4, line 39 to column 5, line 8. See also, column 5, lines 22-36, for a further description of the polyamide composition. Note also column 7, lines 1-6, and column 8, lines 54-59, for a further description of the polyamide composition, including techniques for production thereof. For example, this patent discloses in columns 7 and 8 that the polyamide composition can be prepared directly by condensation of acid and diamine components in suitable proportions or by blending of homopolymer and/or copolymer compositions to achieve the appropriate compositions; or by copolymerizing, e.g., isophthalic acid, terephthalic acid, adipic acid, metaxylylenediamine and hexamethylenediamine in a preferred molar ratio. See also, for example, Example 3 in columns 12 and 13 of this patent. Melt polymerization is used in forming the polyamide.

It is respectfully submitted that this reference does not disclose, nor would have suggested, the polyamide resin as recited in the present claims, formed by the processing recited in the present claims, or having the minimum half crystallizing

time, and advantages thereof; and/or the other features of the present invention as discussed previously, and advantages thereof.

It is respectfully submitted that the additional teachings of Tanaka '415 or Tanaka '741 would not have rectified the deficiencies of Matlack, et al., such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art; and, in addition, even assuming, arguendo, that the teachings of Matlack, et al. with either of Tanaka '415 or Tanaka '741 would have established a prima facie case of obviousness, the evidence of record overcomes such prima facie case and establishes unobviousness of the presently claimed invention.

Tanaka '415 discloses a method for solid-phase polymerizing a crystallizable polyamide being in an amorphous state, which comprises regulating the moisture in the polyamide at the glass transition temperature to at least 0.15% by weight as determined by a Karl Fisher titration thereof, the polyamide being formed from a xylylenediamine and an aliphatic dicarboxylic acid having 4-14 carbon atoms or an aromatic dicarboxylic acid; heating the polyamide thus regulated at a pressure of at least one atm. without reducing the moisture to crystallize the same up to a crystallinity of at least 15%; and, further heating the polyamide thus crystallized at a solid-phase polymerization temperature lower than the melting point thereof under reduced pressure with a batchwise heating apparatus. See column 3, lines 40-53. Note also the paragraph bridging columns 3 and 4 of this patent. This patent discloses a method for drying and for solid-phase polymerizing. Note column 1, lines 7-9. See also column 5, lines 6-15; and column 6, lines 13-19.

It is respectfully submitted that Tanaka '415 is directed to solid-phase polymerization of a crystallizable polyamide. It is respectfully submitted that this patent does not disclose, nor would have suggested, the 2-step polycondensation

respectively of melt-polymerizing and solid-phase polymerization, as in the present claims, much less such 2-step polymerization of the specified diamine and dicarboxylic acid components as in the present claims, or advantages achieved thereby.

Even assuming, arguendo, that the teachings of Tanaka '415 were properly combinable with the teachings of Matlack, et al., such combined teachings would have neither disclosed nor would have suggested the 2-step polycondensing as in the present claims, much less the unexpectedly better results achieved by the present invention utilizing the 2-step polycondensing in combination with the specific components for forming the polyamide, particularly the dicarboxylic acid component, as discussed previously and established by the evidence in the record of the above-identified application.

Tanaka '741 discloses a solid phase-polymerized polyamide suitable for various applications such as bottles, sheets, films, fibers or the like, produced by a step of melt-condensing a diamine component composed mainly of m-xylylenediamine with a dicarboxylic acid component composed mainly of adipic acid, and a subsequent step of heating the resultant polyamide while keeping it solid-phase. See column 1, lines 5-13. Note also column 5, line 59 through column 6, line 19, of this patent, disclosing a polyamide formed utilizing a dicarboxylic acid component containing not less than 80 mol% of adipic acid. See also column 7, lines 7-22; and column 8, lines 60-64, of this patent. Note that in the Examples, poly-m-xylylene adipamide (i.e., 100 mol% adipic acid as the dicarboxylic acid component) was used.

Even assuming, arguendo, that the teachings of Matlack, et al. and Tanaka '741 were properly combinable, such combined teachings would not have taught or

suggested the minimum half crystallization time, and would not have taught or suggested unexpectedly better results achieved according to the present invention utilizing the combination of Features 1 and 2 as in the present claims.

Harada, et al. discloses a gas-barrier multi-layered structure which includes at least one layer of a specified copolyamide composed of a specific dicarboxylic acid component and specific diamine component, and at least one layer of a thermoplastic resin other than the copolyamide. Note, column 1, lines 4-11; see also column 2, lines 20-33. Note further, column 2, lines 43-45 and 49-58. Note also column 3, lines 16-18 and 31-35. See further, column 5, lines 11-14. As applied by the Examiner, Comparative Example 2 discloses a copolyamide obtained from adipic acid, isophthalic acid, terephthalic acid and MXDA (m-xylylenediamine) (mol ratio 83/11/6/100) as starting materials.

Initially, it is noted that the copolyamide of Harada, et al., relied on by the Examiner, is in a comparative example, not within the scope of the polyamides in the invention of Harada, et al. Taking the teachings of Harada, et al. as a whole, as required under 35 USC 103, it is respectfully submitted that the combined teachings of the applied references would have taught away from such dicarboxylic acid component as in claim 10.

It is respectfully submitted that the present circumstances differ from the situation where the disclosure in a teaching reference relied upon by the Examiner is an “unpreferred embodiment” of the teaching reference; it is respectfully submitted that the comparative example in Harada, et al., relied on by the Examiner is different from an “unpreferred embodiment”, and in fact Harada, et al. teaches away from the comparative example.

Tanaka '415 and Tanaka '741 have previously been discussed.

Even assuming, arguendo, that the teachings of Harada, et al. as applied by the Examiner were properly combinable with the teachings of Tanaka '415, it is respectfully submitted that such combined teachings would have neither disclosed nor would have suggested the presently claimed structure including, inter alia, the polyamide produced by the 2-step polycondensing as in the present claims. As discussed previously, it is respectfully submitted that Tanaka '415 does not disclose, nor would have suggested, the 2-step polycondensing as in the present claims.

Furthermore, with respect to the combination of the teachings of Harada, et al., as applied by the Examiner, with the teachings of either of Tanaka '415 and Tanaka '741 as applied by the Examiner, the combined teachings of these references do not disclose, nor would have suggested, the unexpectedly better results achieved by the present invention having the Features 1 and 2 as discussed previously.

Noting Item 8 on page 6 of the Office Action mailed August 31, 2006, it is respectfully submitted that the combined teachings of Matlack, et al., Tanaka '415 or Tanaka '741, and Harada, et al., would have neither taught nor would have suggested the subject matter of claims 6 and 12, including the minimum half crystallization time of the crystallizable polyamide resin, or, in particular, the unexpectedly better results achieved as discussed previously.

In view of all of the foregoing comments and amendments, reconsideration and allowance of all claims presently pending in the application are respectfully requested.

To the extent necessary, Applicants hereby petition for an extension of time under 37 CFR 1.16. Kindly charge any shortage of fees due in connection with the filing of this paper, including any extension of time fees, to the Deposit Account of Antonelli, Terry, Stout and Kraus, LLP, Account No. 01-2135 (case 396.43206X00), and please credit any overpayments to such Deposit Account.

Respectfully submitted,

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